

INEEL Subsurface Science Research

Safeguarding our Nation's Water

With more than fifty percent of the U.S. population depending on aquifers for their drinking water, protecting groundwater from contamination is a national priority. Responsibility for preventing surface and groundwater contamination is given to several federal agencies – the Departments of Energy, Interior and Agriculture, the Environmental Protection Agency, the Army Corps of Engineers, among others – as well as to state, county and municipal agencies. Because of a rapidly growing threat of aquifer contamination in our industrialized society, each of these organizations needs dramatically improved technology to avert damage to water supplies. The INEEL's Subsurface Science Research is a major undertaking designed to help safeguard our precious groundwater supplies by applying science to develop a better understanding of subsurface processes and how

they control the movement and degradation of contaminants in the subsurface over time.

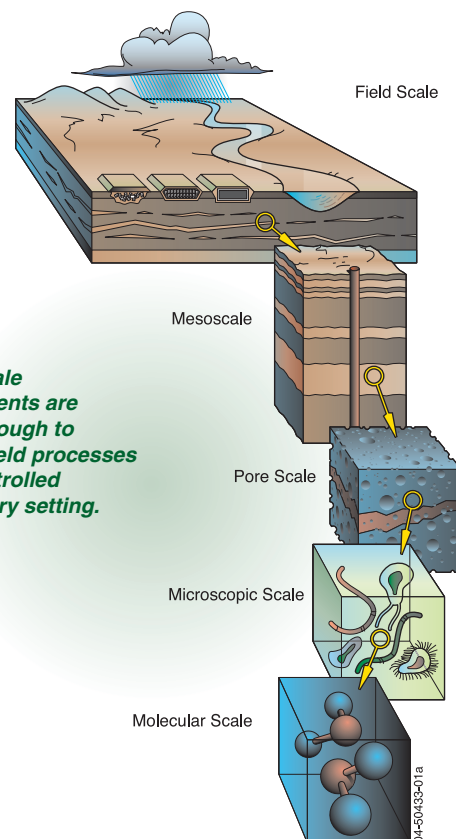
The primary motivation for the Subsurface Science research is to develop the scientific basis and new technology needed to remediate and monitor sites having radioactive and chemical contaminants in the ground as a result of research to develop weapons and peacetime uses of nuclear energy. Our work will also make important contributions to homeland security through developing ways to mitigate the effects of chemical or biological contaminants introduced into soils, surface waters or ground waters; preventing agricultural fertilizers and pesticides from contaminating underlying aquifers; cleaning up contamination from mining and industrial sites across the country; and developing safer methods to dispose of municipal waste in the subsurface.

Our Program

The research effort encompasses a broad range of scientific inquiry—including geology, geophysics, hydrology, biology, chemistry and computational science—to address nationwide environmental management issues. A world-class review board, collaboration with governmental agencies working on site remediation groundwater problems, and recommendations from the National Research Council guide the INEEL program. Our research focus includes development and validation of predictive models to guide programs aimed at preventing or remediating contamination, engineering of robust waste contaminant systems to prevent contaminants from reaching groundwater supplies, and developing reliable monitoring systems to provide early warning of problems before extensive damage is done.

Mesoscale Research to Bridge the Gap Between Laboratory and Field

INEEL's scientists are conducting mesoscale experiments—research designed to bridge the gap between traditional bench-scale experiments and field-scale observations—to provide a better understanding of subsurface contaminant behavior. Our approach is to mimic complex field processes in a controlled laboratory setting. It has been found that in many cases, laboratory data are not applicable at the field scale. Mesoscale experiments enable scientists to study the combined effects of biological, geological, chemical and physical processes on contaminant movement and fate at field-relevant scales. Better understanding of these processes enables scientists to improve subsurface simulation models and to build better long-term monitoring systems.



Subsurface Research Challenges

The earth's subsurface is highly complex and variable—in both its physical and chemical properties and in geochemical, microbiological and fluid-flow processes. Our limited understanding of these properties and processes creates a barrier to making science-based decisions on remediation and stewardship of contaminated sites. Major research focus areas include:

- **Modeling**—developing and validating more accurate predictive models of contaminant fate and transport in subsurface soils, rocks and water
- **Coupled phenomena**—furthering scientific understanding of the interplay of biological, chemical and geological factors in subsurface contaminant behavior and remediation
- **Scaling**—gaining a better understanding of spatial and temporal scaling so that observations based on laboratory data can be made relevant to the realities of the field
- **Characterization**—developing new and improved technology for mapping the three-dimensional distribution of subsurface properties, and the location and nature of contaminants
- **Risk assessment**—enhancing the reliability of risk assessments to aid selection among options for environmental remediation and monitoring
- **Containment systems**—developing highly durable containment and stabilization systems for a range of contaminants, including long-lasting reactive barriers, caps and covers
- **Monitoring systems**—developing durable monitoring systems to validate containment system performance and provide early warning of failure, including sensors with enhanced lifetimes in the subsurface. Emphasis is on noninvasive geophysical and geochemical techniques as alternatives to sensors placed in expensive bore holes.

Partnering—Joining Today for Tomorrow's Answers

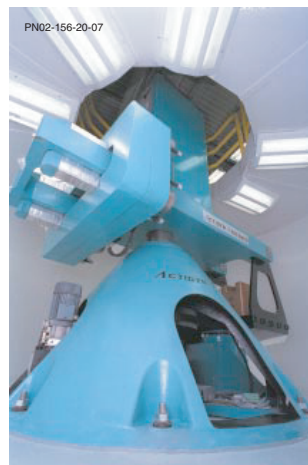
We are pursuing research through the use of coordinated multidisciplinary experimental campaigns to achieve results greater than those that could be achieved by individual researchers working alone. INEEL's Subsurface Science research creates an opportunity for scientists, engineers and students to collaborate on cutting-edge research into subsurface contamination problems. As part of its technical approach, the program is emphasizing multidisciplinary, multi-institutional research and technology development teams, initiated either by INEEL scientists or by researchers from other national laboratories, industry and academia. Through compelling collaborations, the research brings together the best technical minds in the world with state-of-the-art scientific tools to address the nation's environmental needs.

Building INEEL's Scientific Capability

We are committed to augmenting our research capabilities in all the geoscience disciplines. To achieve this, we've begun hiring new staff and acquiring new experimental and computational equipment and facilities. For more information about employment or collaborative research opportunities, please contact us.



PN00-572-03-17



PN02-156-20-07

Researchers study how water flows through subsurface rock and soil using centrifuges, such as INEEL's two-meter, 50 gravity-tonne geocentrifuge shown at left.

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